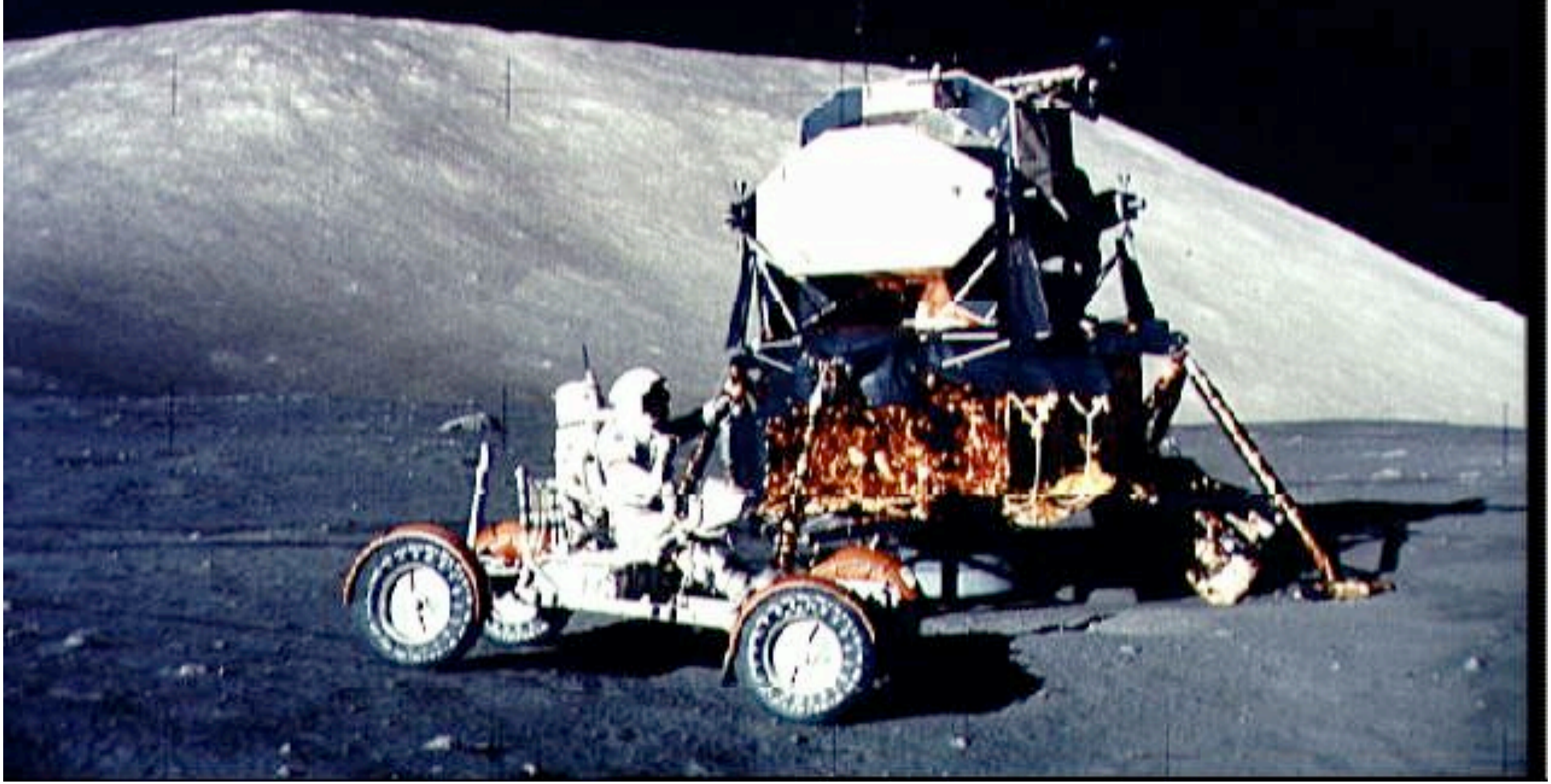
Human Systems & Robotics

Dr. Rob Ambrose, NASA JSC

November 2007

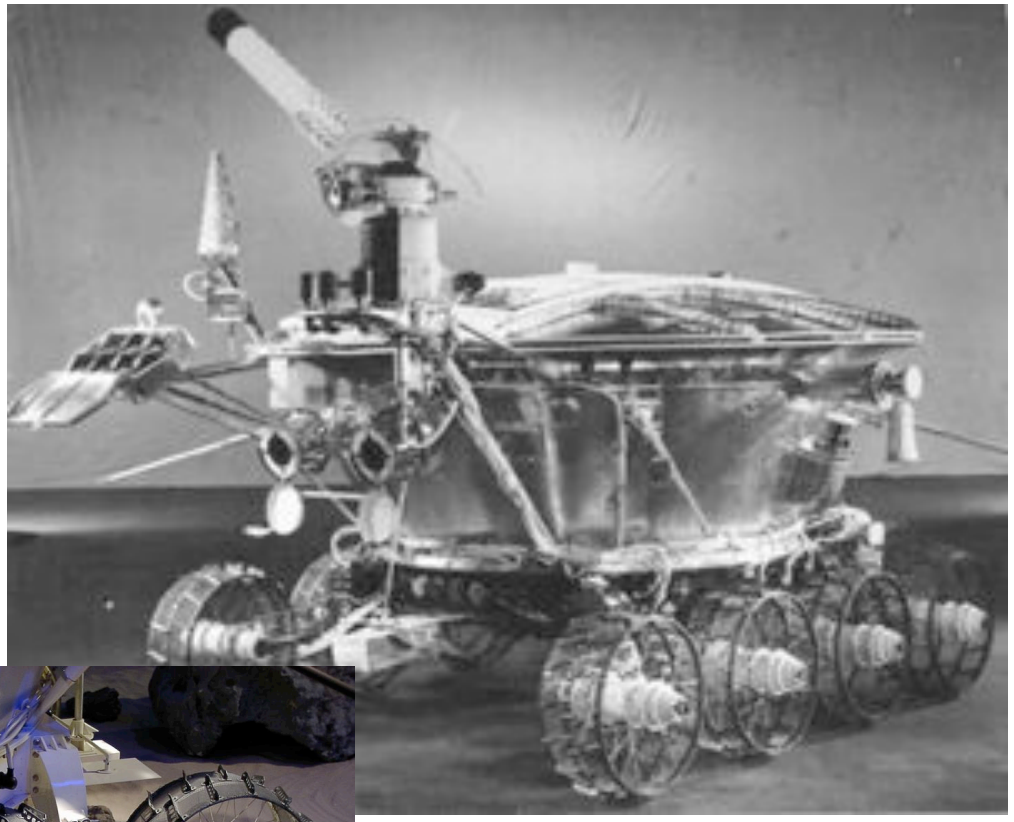


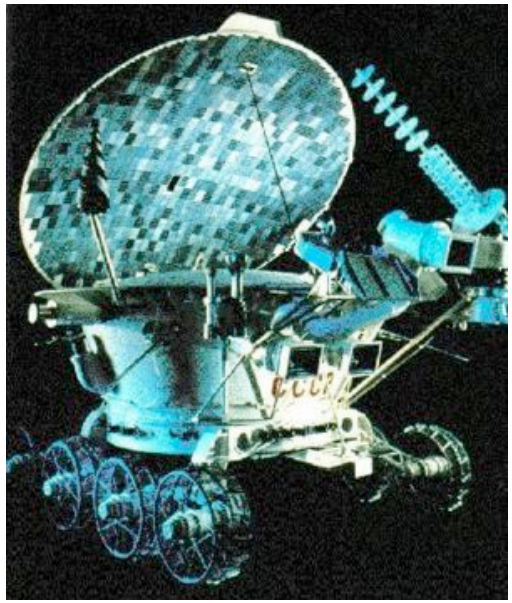
- I'm no Gene Kranz
- Robotics is Enabling the Architecture

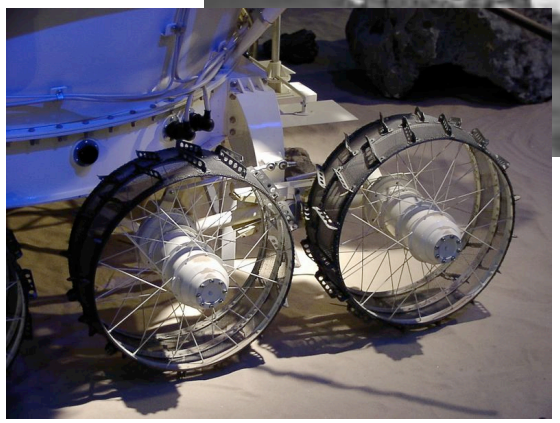
- Turning those Concepts into Reality

Lunokhod

- First Flight April 1970
- Lunokhod 1 & 2
- 840 Kg Mass
- 1 & 2 KPH
- 37 Km Life Range (L2)

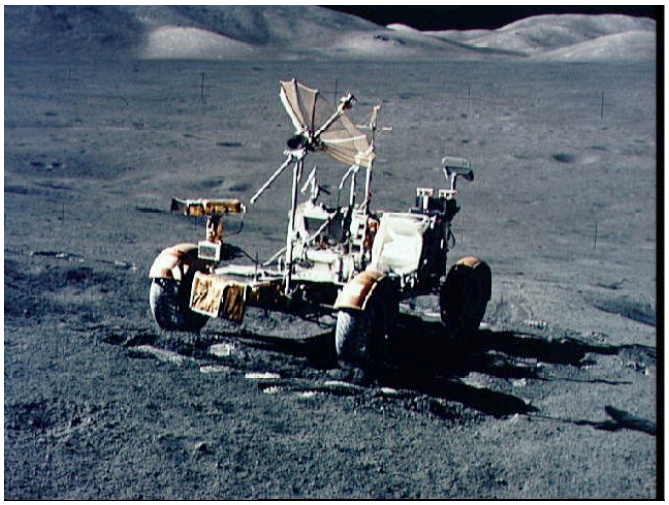


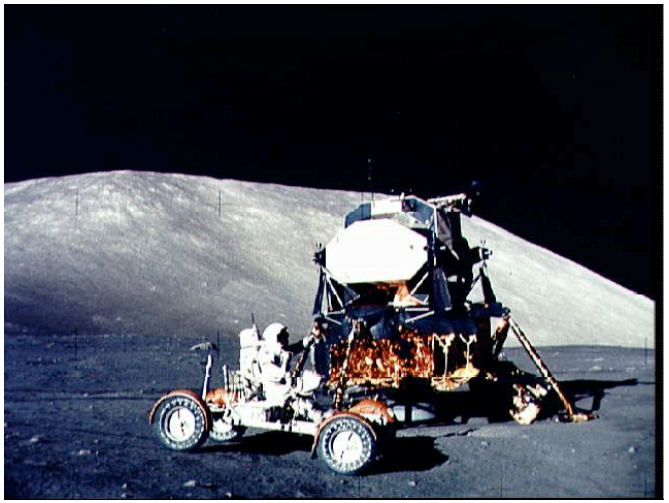


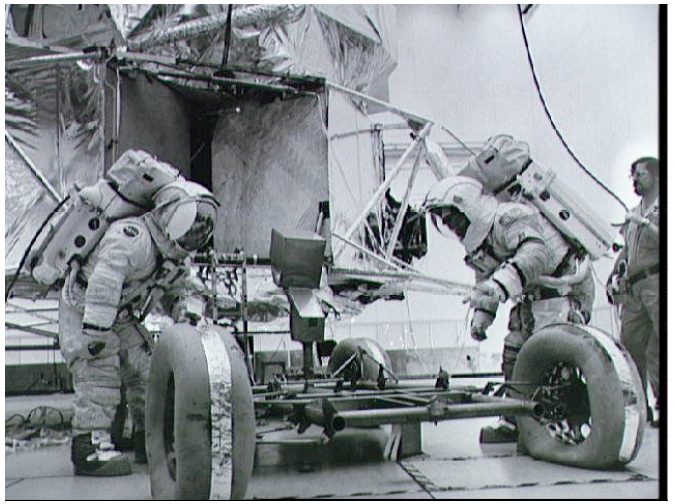


Apollo Lunar Roving Vehicle (LRV)

- First Flight April 1971
- Apollo 15, 16 & 17
- 210 Kg Mass
- 1/6g Payload 490 Kg
- 15 KPH
- 100 Km Life Range

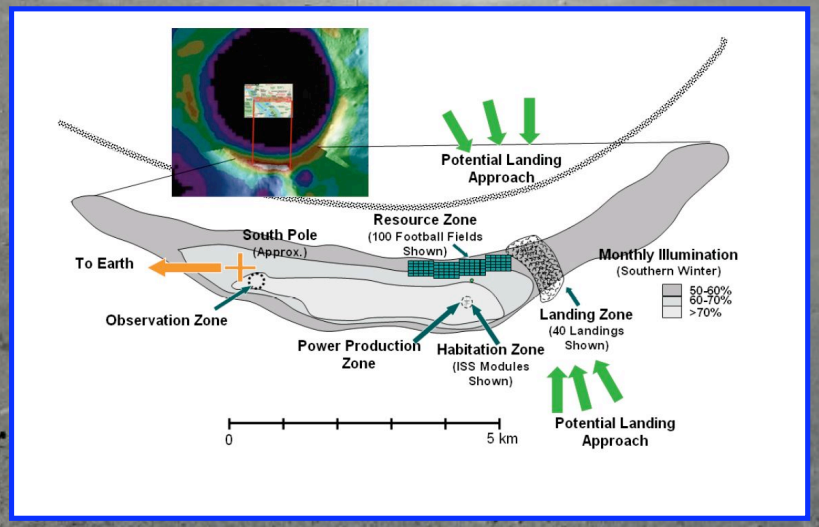






Apollo Lunar Roving Vehicle (LRV)

Robotic Perspective on NASA's Exploration Architecture



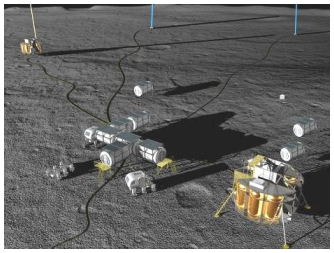
Surface Mobility

Surface Handling

Human-Systems Interaction

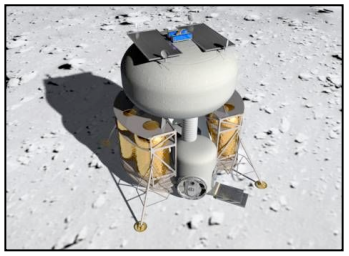
LAT-2's Architectural Options

- Option 1 Results from LAT-1
- Option 2 "Mini-Habs"



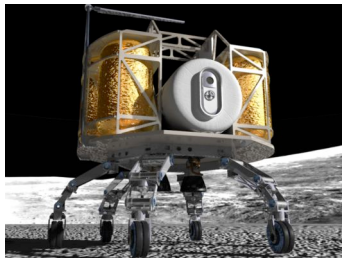
Habitats removed from Lander

- Option 3 "Monolithic Hab"



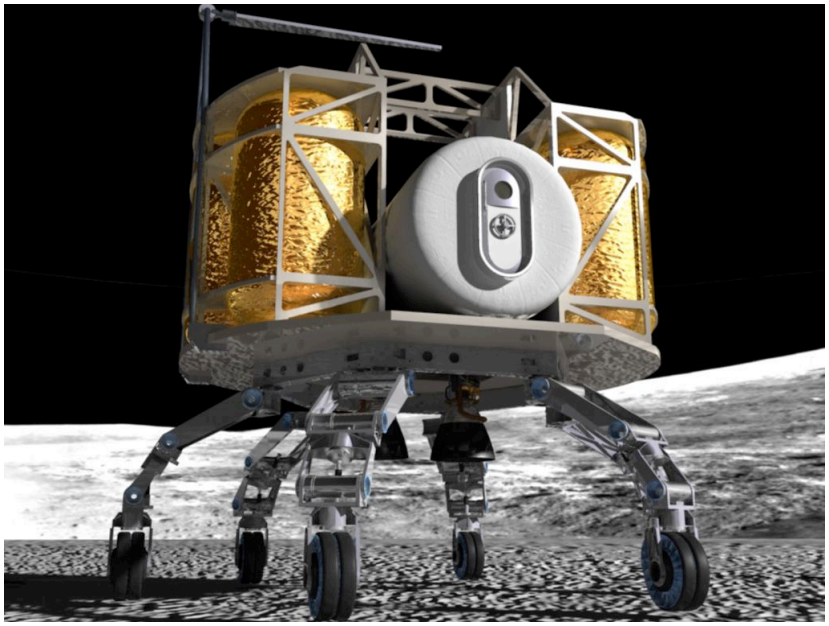
Habitat remains on Lander

- Option 4 "Mobile Lander"



Mobile Habitats

Architecture Concept– Mobile Habitat

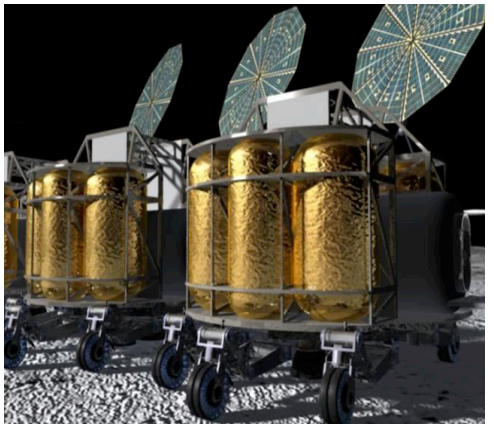


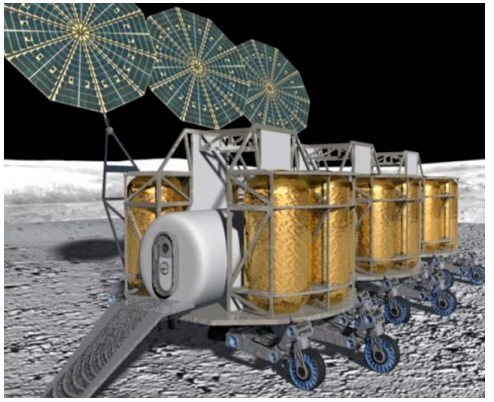
<20,000 Kg Payload

Integrated Power

Docking Together

1000+ Km Range





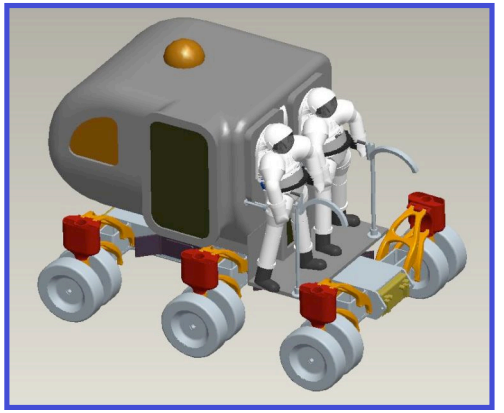
Architecture Concept– Small Pressurized Rover

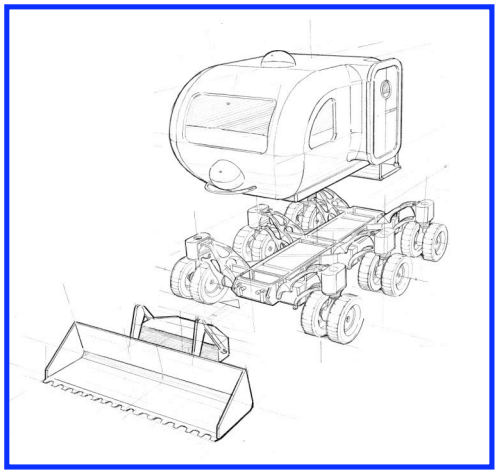
Fast Out the Door

Radiation Protection

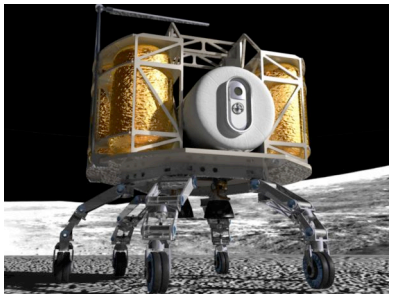
Hatch Docking

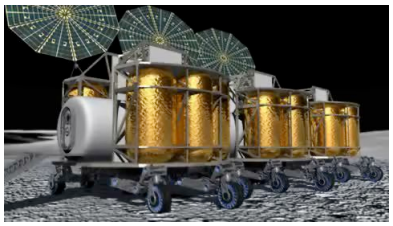
100+ Km Range

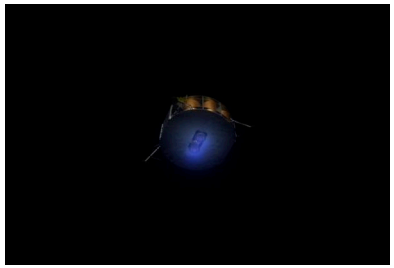


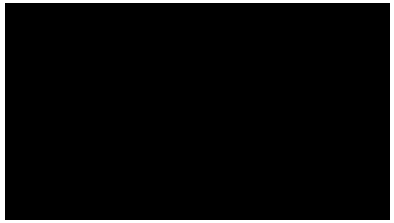


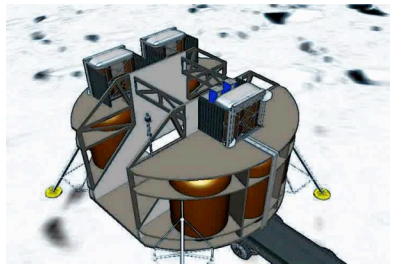
Architecture Concepts

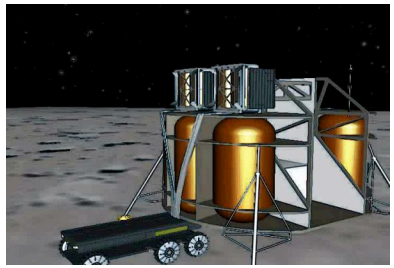


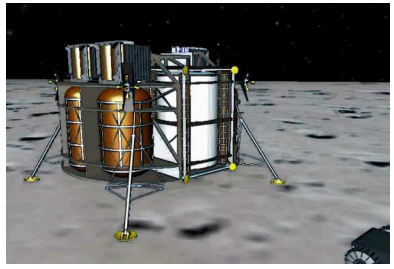












NASA's Exploration Technology Development Program

Turning the Cartoons into Reality

Exploration Technology Development Program

- The Exploration Systems Mission Directorate (ESMD) created this technology program in 2005.
  - Exploration Technology Development Program (ETDP)
  - ETDP Managed by ESMD Advanced Capabilities Division
  - Program office located at NASA Langley Research Center (LaRC)
  - Point of contact is Frank Peri (frank.peri-1nasa.gov)
  - Dana Gould & Diane Hope are the Element Managers

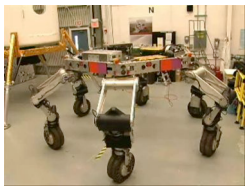
- Broad portfolio of projects, with engineering focus
  - Propulsion, life support, power, human-robotics systems
  - Focused on technology for exploration needs
    - Crew Launch Vehicle (CEV)
    - Launch Systems
    - Surface Systems

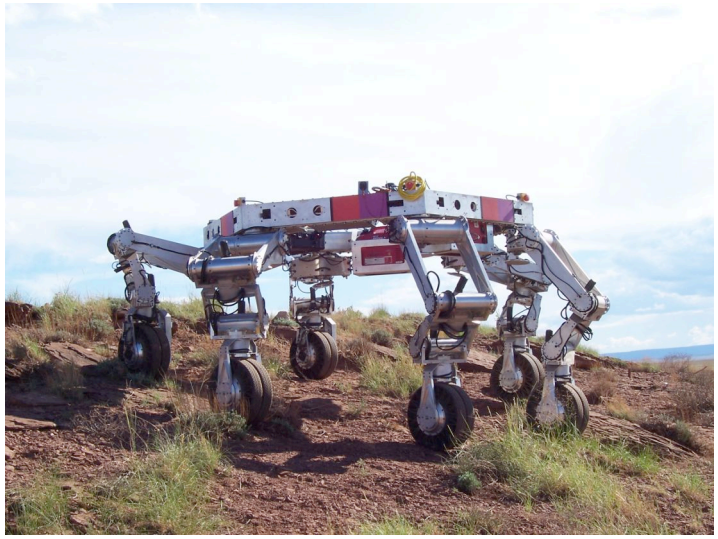
- Driven by need dates and Technology Readiness Levels (TRL)
  - Exploration systems have development milestones
  - Technology is matured to be at TRL-6 by Preliminary Design Reviews (PDR's)

HRS

Technology Description (ATHLETE)

- Leadership
  - NASA JPL
  - B. Wilcox
- Technologies
  - Wheel-on-limb Mobility
  - Mobility & manipulation
  - Active suspension
  - Payload offloading
  - Habitat docking
  - Hatch mating
- Collaborations
  - Stanford (Latome)
  - Michelin (Switzerland)





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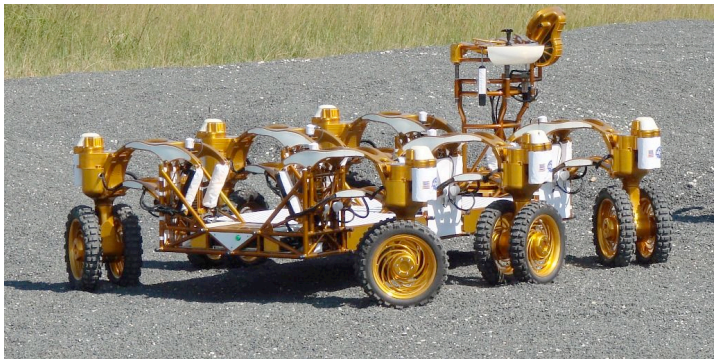
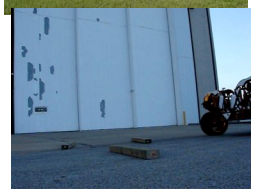
Technology Description (Chariot)

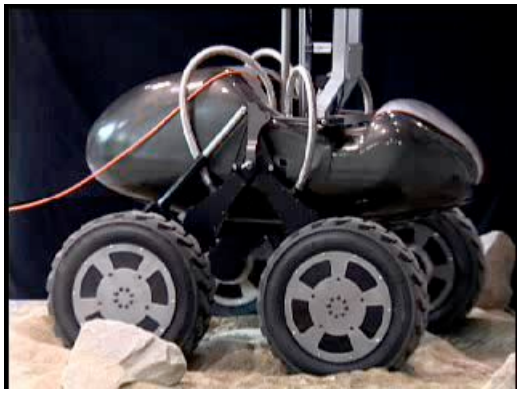
- Leadership
  - NASA JSC
  - Ambrose, Bluethmann, Junkin
- Technologies
  - Novel chassis kinematics
  - Active/Passive suspension
  - Upright crew accomodations
  - Chassis leveling
  - Small Pressurized Rover Ops
- Collaborations
  - ETDP Advanced Suits
  - ETDP Thermal Control
  - ETDP ISRU
  - ETDP Power





Technology Description (Scarab)

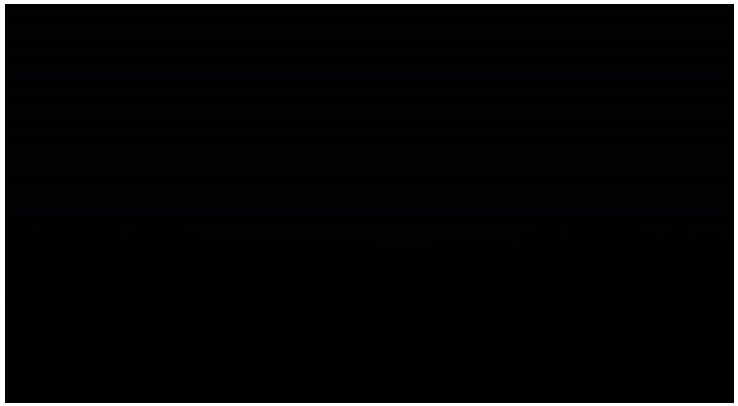
- Leadership
  - NASA GRC & CMU
  - Whittaker, Caruso
- Technologies
  - Novel chassis kinematics
  - Integrated drill
  - Wheel spikes for drilling
  - Dark navigation
- Collaborations
  - CMU
  - NorCat
  - ETDP ISRU



HRS

Technology Description (Centaur)

- Leadership
  - NASA JSC
  - Ambrose, Diftler, Bluethmann
- Technologies
  - Autonomous Manipulation
  - Dexterity
  - Mobile Manipulation
  - Time Delayed Supervision
  - Astronaut Assistance
  - Surface Science
- Collaborations
  - UMass (Grupen)
  - MIT (Brooks)
  - Vanderbilt (Peters)
  - Many earlier grants

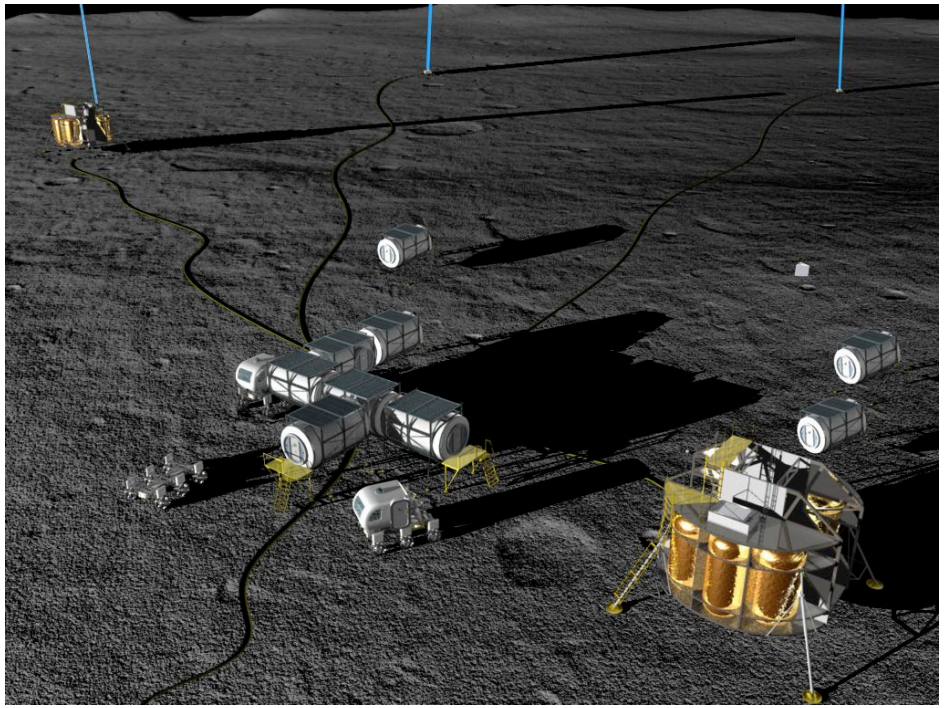


Surface Scenario Video (2 minute)

Crater Access Scenario Video (2 minute)

Plans for FY08

- 2008 Field Test
  - ATHLETE, Chariot, Scarab, K-10's, Crane
  - December Workshop
  - June Test
- New Technologies for 2009
  - Pressurized cabin mockup
  - New batteries & fuel cells
  - Chariot crew accommodations
  - 1/6g ATHLETE testing
  - New wheels
  - New drives
  - New supervision software



HRS Team
(7 NASA Centers and 10+ Companies)